LXI. RESEARCHES ON THE FAT-SOLUBLE ACCESSORY SUBSTANCE. IV: NUTS AS A SOURCE OF VITAMIN A.

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THE examination of a large number of animal and vegetable fats and oils for the presence of the fat-soluble A accessory food factor suggested to the authors the desirability of investigating raw nuts, known to be rich in fats, for the same vitamin. Certain nut butters had already been examined by Halliburton and Drummond [1917], who had come to the conclusion that they were not equal to butter in this respect, but that there were "certain indications which made it probable that the nuts themselves do in some cases contain the accessory factors in small amount." The literature has not provided accounts of any similar work on the subject, although the vitamin B has for some time been known to occur in large quantities in the coconut and pea-nut [Daniels and Loughlin, 1917; Johns, Finks and Paul, 1919], and, more recently, has been found in the almond, English walnut, Brazil nut and chestnut by Cajori [1920].

EXPERIMENTAL METHOD.

The method adopted for the investigation was the one usually followed in this laboratory. Rats of 50–70 g. weight were fed on an unlimited allowance of a basal diet consisting of

Purified caseinogen	...	18 grs.
Purified starch		52 "
Salt mixture		5 "
Yeast extract (marmite)		5 "
Hardened cotton seed oil...		15 "
Orange or lemon juice	...	5 cc.

mixed with sufficient cold water to form a stiff paste. Fresh water for drinking and cleaning purposes was supplied daily. The rats were weighed twice a week and when they had ceased growth and their weights had remained practically stationary for four successive weighings, they were fed daily with

approximately 1 g. per rat of the nut to be tested. The eagerness with which the rats came to eat their nuts made this a comparatively simple matter, most of them consuming their ration immediately, and in only one experiment, that of the almonds, were any portions left uneaten on the following morning.

RESULTS.

The weights in g. of the rats on the nuts tested are given in the following table.

Nuts		Number of days after commencement of nut supplements									
		0	4	7	10	14	18	21	25	28	32
Pea-nuts 38.8 % fat	Rat 80 ♀	110	120	118	117	114	109	109	110*	110	110
	„ 81 ♀	80	86	81	86	92	91	91	100	101	100
	„ 82 ♀	78	82	79	79	81	78	80	77*	80	74
Brazil nuts 66.8 % fat	„ 83 ♂	107	120	120	99	102	118	120	120		
	„ 85 ♀	92	100	97	99	99	100	99	102*		
	„ 84 ♀	80	90	89	90	95	94	95	98*		
Butter nuts 60 % fat	„ 55 ♀	72	77	71	67	70					
	„ 54 ♀	88	92	93	92	90					
	„ 56 ♀	86	104	104	107	104					
Barcelona nuts	„ 80 ♀	110	120	118	125	123					
	„ 81 ♀	100	100	107	109	109					
	„ 82 ♀	74	62	70*							
Almonds 55 % fat	„ 83 ♂	122	124	130	140	130*					
	„ 85 ♀	106	101	100	101	98					
	„ 84 ♀	93	94	96	91	89					
Walnuts 62 % fat	„ 55 ♀	76	79	78	81	81					
	„ 54 ♀	100	102	105	101	102					
	„ 56 ♀	113	115	122	115	112					

Rats 80, 82, 84, 85, 83 developed a bad form of the characteristic eye disease associated with a deficient supply of vitamin A at points marked *.

DISCUSSION.

The results are interesting in view of the opinion which is steadily gaining ground that vitamin A is found most abundantly in actively assimilating green plant tissues and to a much smaller extent in resting tissues, such as occur in all seeds, and the special food storehouses in the roots and stems of certain plants. The nuts used were chosen somewhat at random from those usually considered desirable by vegetarians, many of them, as shown in the table, having a high fat content. Structurally, they show some variation. The almond, walnut, pea-nut and Barcelona nut, although not strictly speaking all true "nuts," are true seeds and show well-defined plumule and radicle, while the mass of the seed is filled with cotyledons containing the reserve food store. The Brazil nut has a mass of endosperm in which are embedded the growing points, not fully enough developed to be visible to the naked eye; and the butter nut has probably a similar structure. As the results

showed an almost complete absence of vitamin A from all the six kinds of nuts, no distinction can be drawn between tissues which are purely reserve tissues and those which have potentially another function, such as assimilation, as have the cotyledons of the almond. This suggests that the vitamin must be developed at some stage subsequent to germination, and the authors hope shortly to publish results of work which support this view.

In view of the recent work on the thermostability of vitamin A, another point had to be investigated. Inquiry in one direction showed that pea-nuts are "roasted" before being sent to the market, though at what temperature or for what length of time, no exact information could be obtained. On the other hand another source of information denied any roasting of the nuts previous to their appearance on the market. English walnuts are dried in the open air, but there are no grounds for thinking that this process or that which Brazil nuts, Barcelona nuts, butter nuts and almonds normally undergo before they are sold as food causes any destruction of vitamin A.

The nuts were tested for the presence of the lipochromes, carotene and xanthophyll, by the method described in the previous paper on fats and oils by the authors. In no case was more than a mere trace of pigment found, and this failed to give characteristic lipochrome reactions with strong sulphuric acid, nitric acid, and iodine in potassium iodide solution.

CONCLUSIONS.

1. The nuts examined, Brazil, Barcelona, pea, walnuts, almonds and butter nuts, although containing large percentages of fats, possess a relatively low food value as sources of the vitamin A often associated with fats.
2. These results furnish additional evidence for the theory that vitamin A is formed in the green part of the living plant and is not stored to any appreciable extent as such in the seed and other resting tissues.

REFERENCES.

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